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[54] **APPARATUS FOR COATING THE EXTERIOR OF ROD-LIKE MEMBERS**

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[52] **U.S. Cl.** **118/264**; 118/265; 118/266; 118/208; 118/209; 118/DIG. 11

[58] **Field of Search** ..... 118/264, 265, 118/266, 208, 209, 58, 66, 712, DIG. 11

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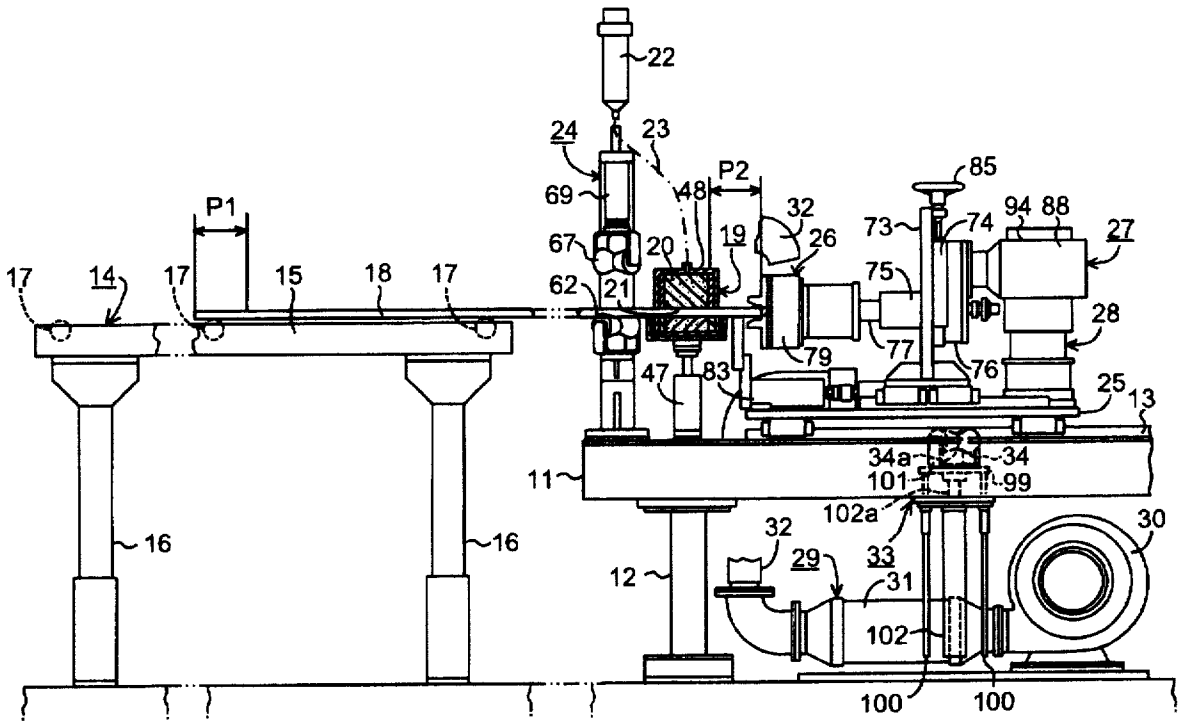
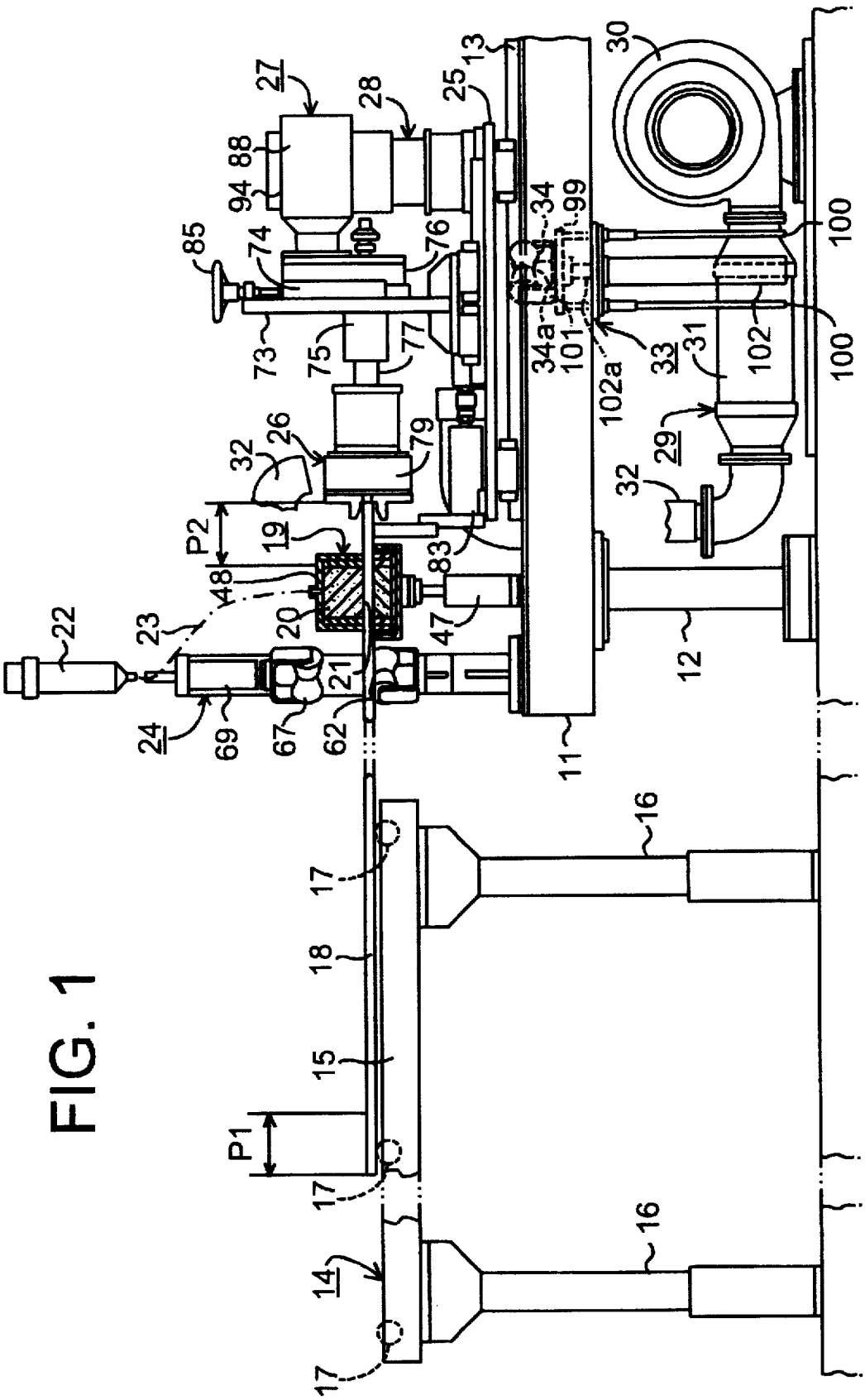
Assistant Examiner—Michael P. Colaianni
Attorney, Agent, or Firm—Parkhurst & Wendel

[57] **ABSTRACT**

A coating apparatus for coating an outer peripheral surface of a rod-shaped workpiece with a covering material, comprising an elastic body having a covering material-impregnatable property and provided with an insertion hole through which the workpiece is to be passed, and a moving mechanism for moving the workpiece relative to the elastic body through the insertion hole, wherein the outer peripheral surface of the workpiece is coated with the covering material impregnated in the elastic body, when the workpiece is passed through the insertion hole of the elastic body by the moving mechanism.

12 Claims, 8 Drawing Sheets

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P2
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P1
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FIG. 1

FIG. 2

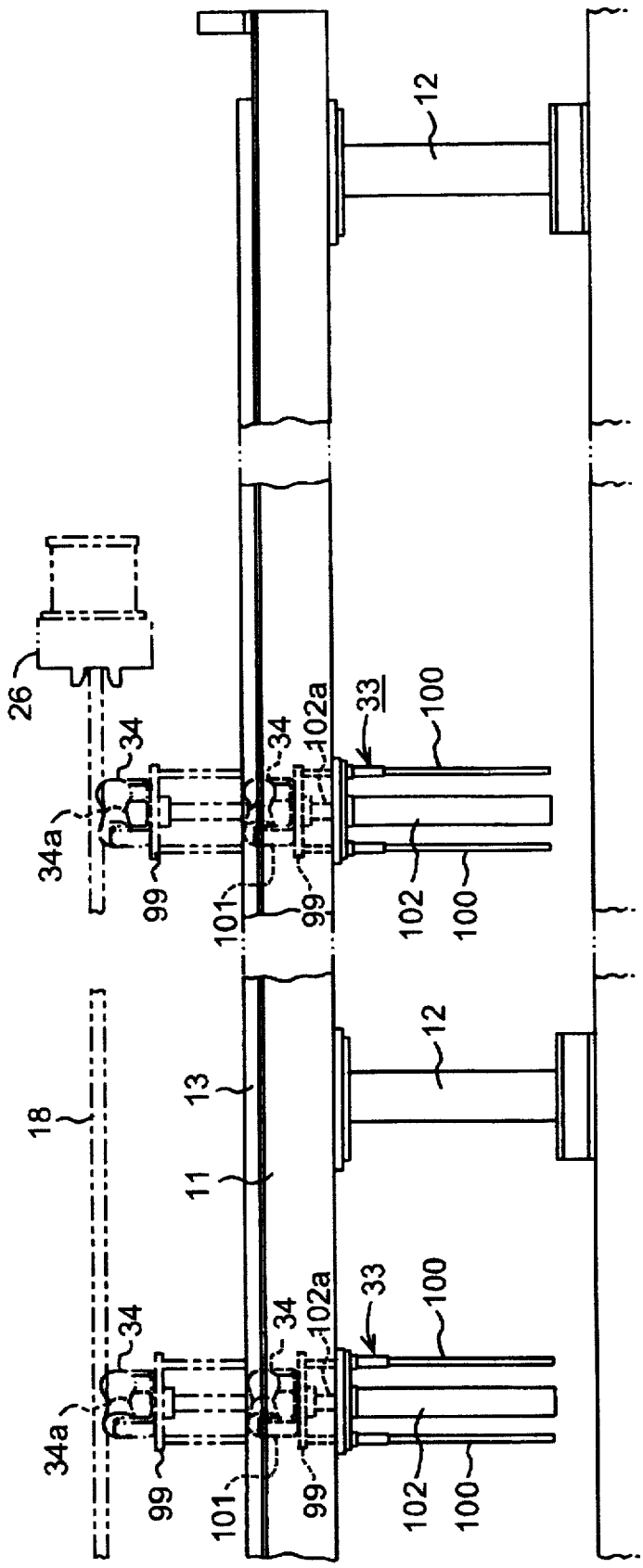
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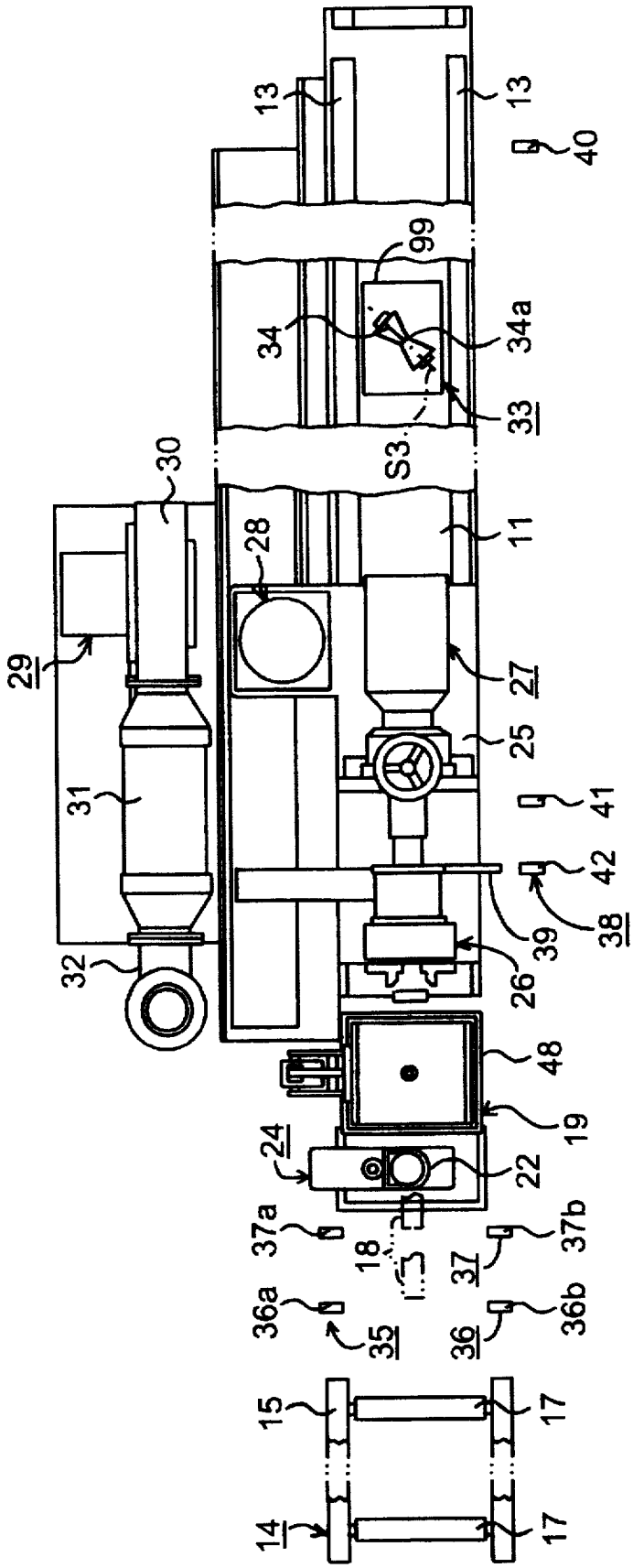
FIG. 3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37a
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37b
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36b
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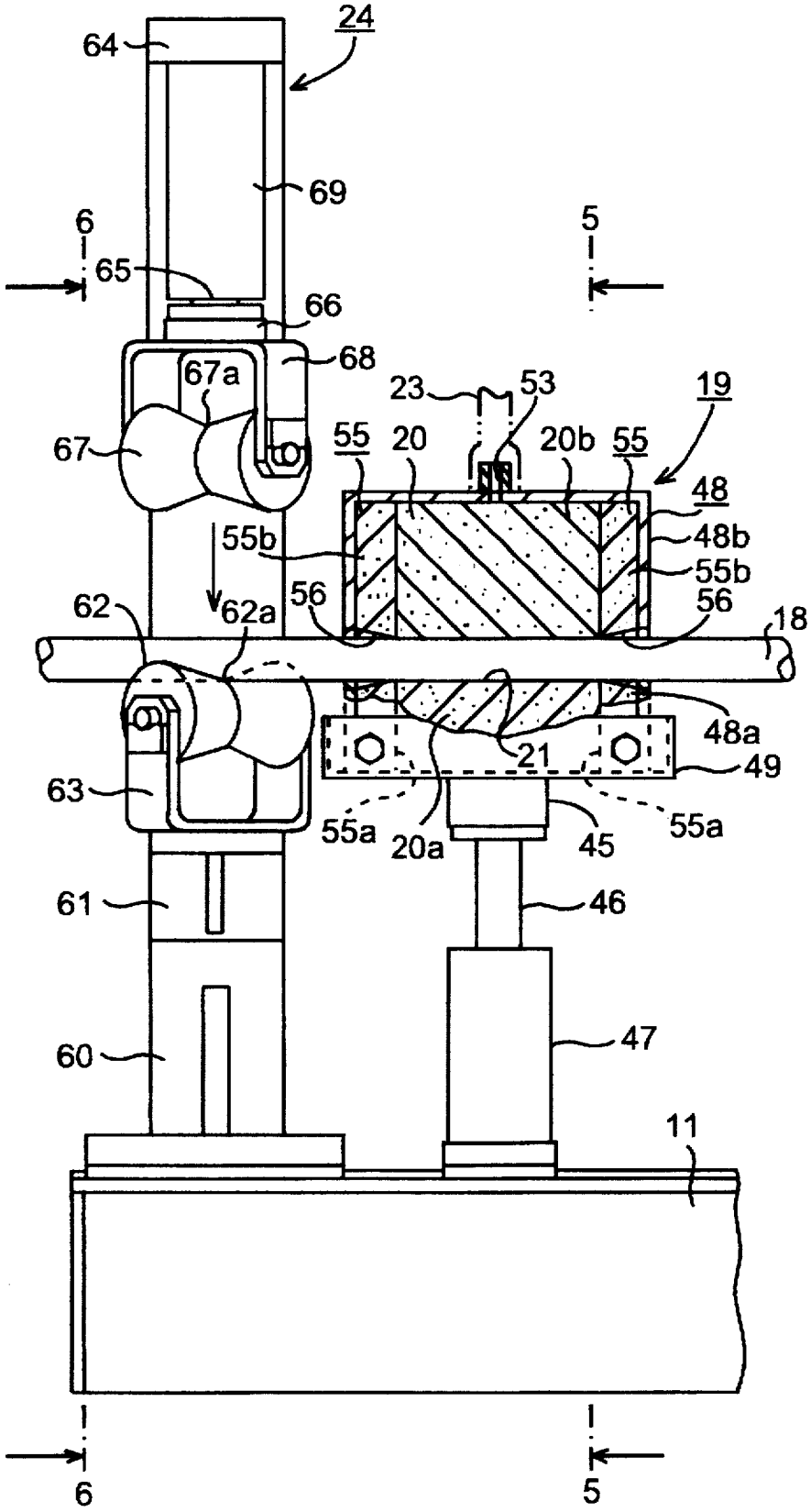
FIG. 4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20b
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48b
55b
62
62a
56
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FIG. 5

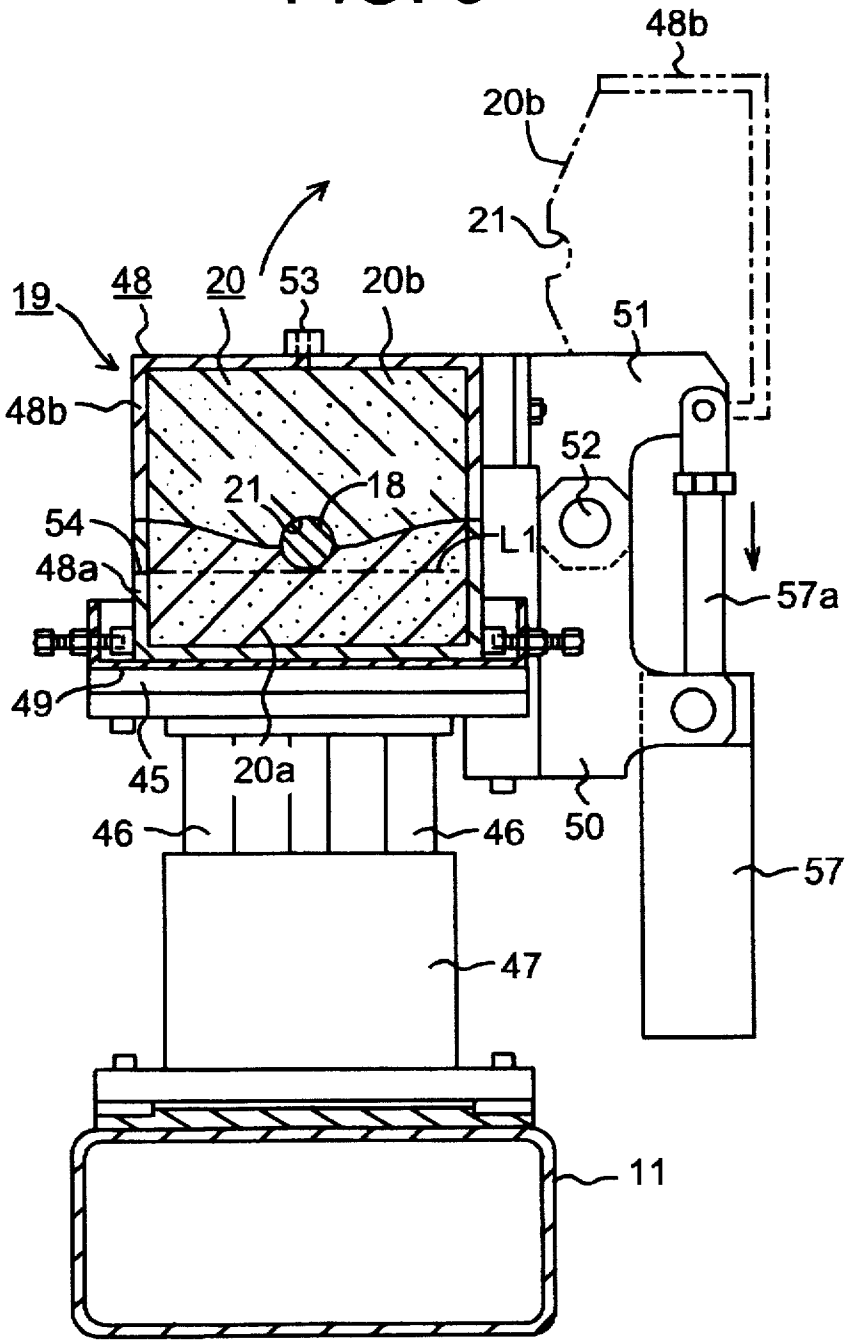
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FIG. 6

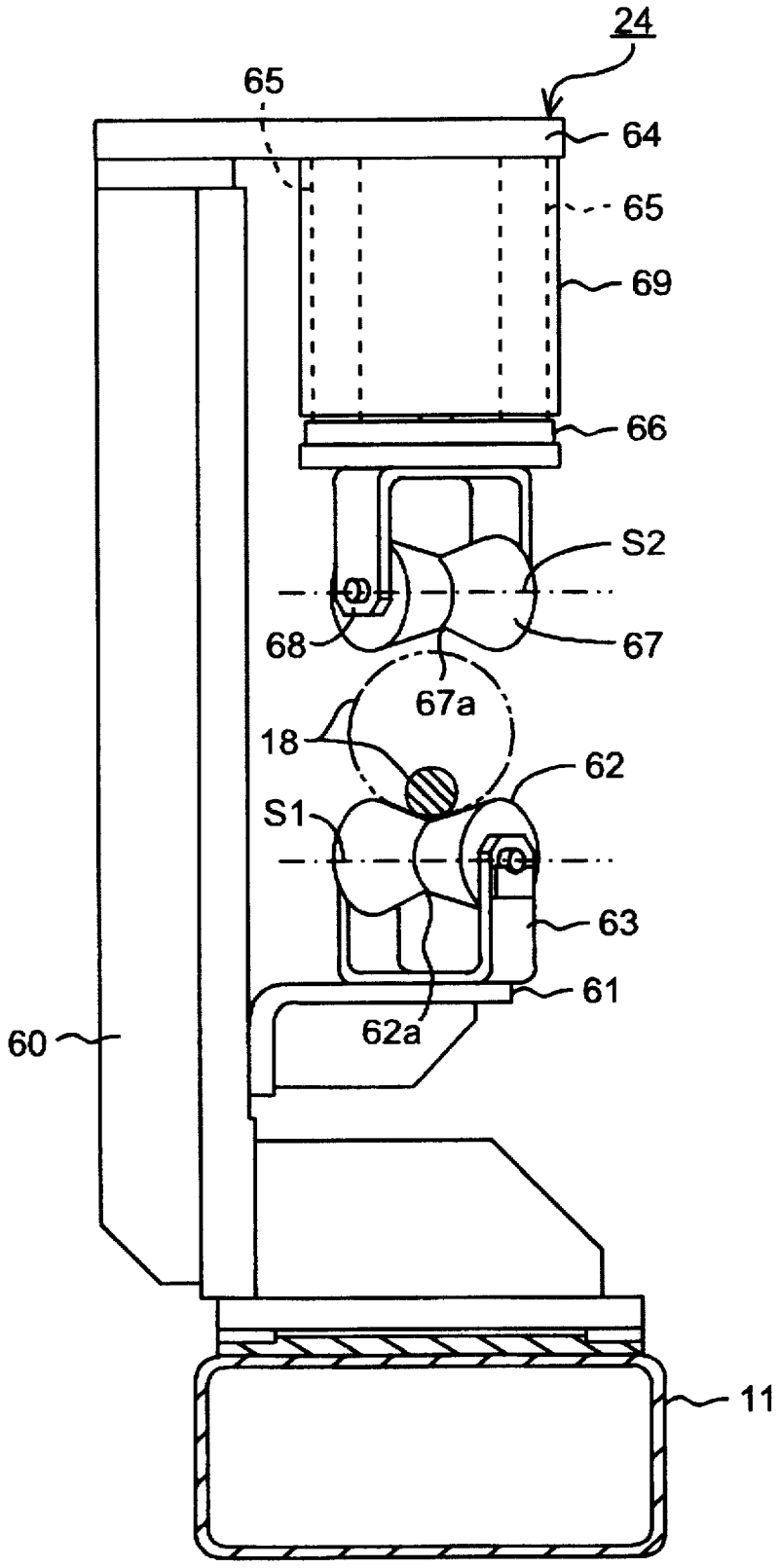
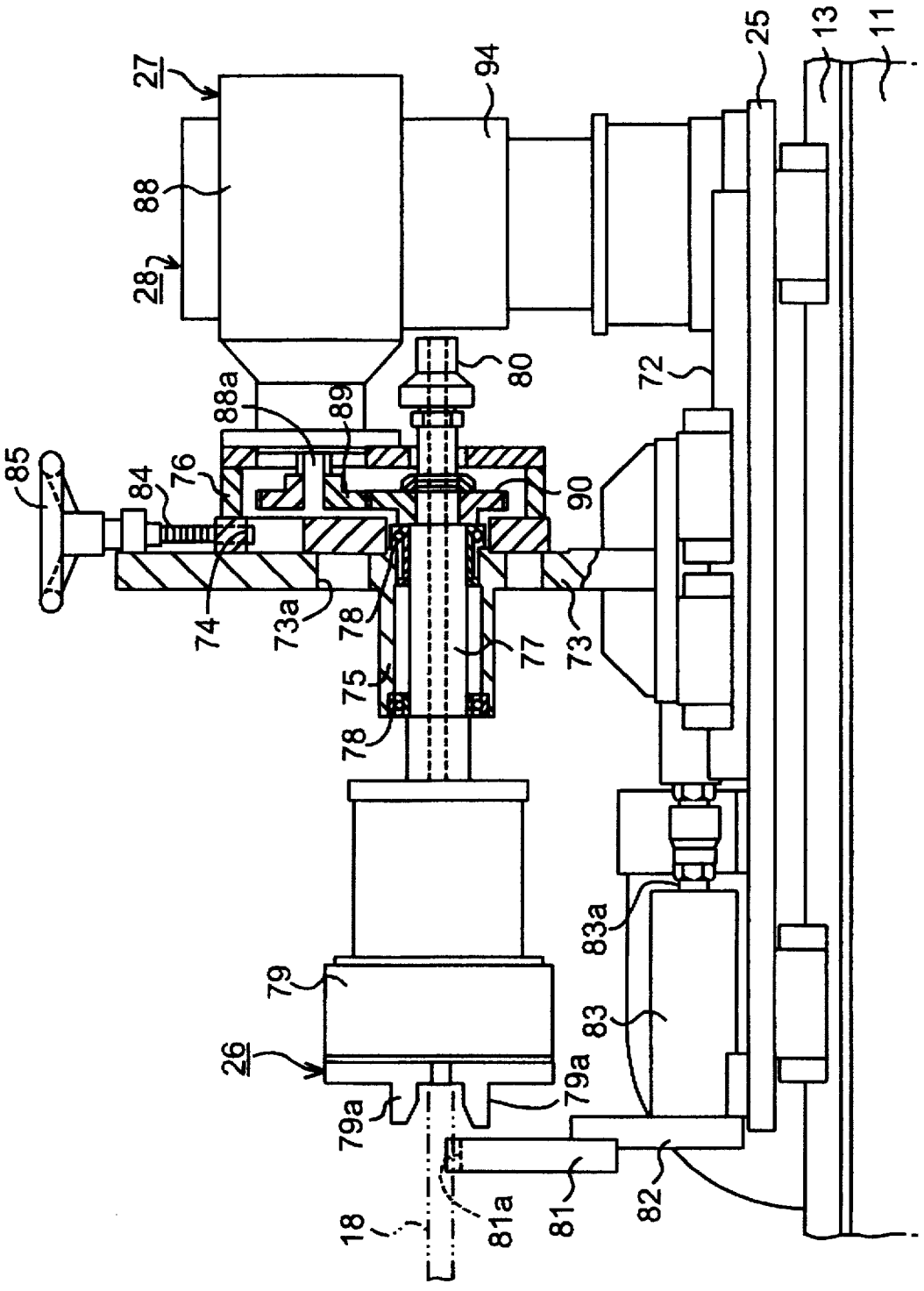


FIG. 7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81a
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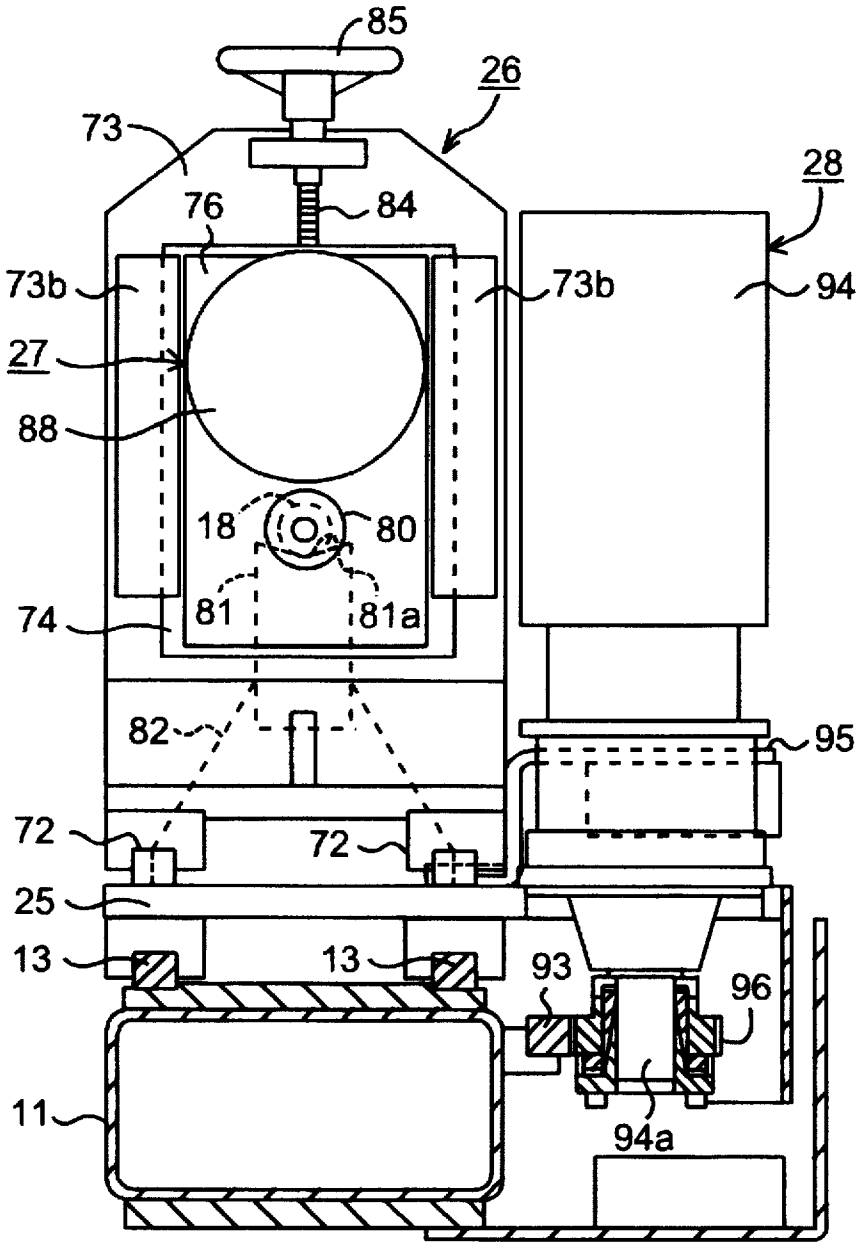
FIG. 8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APPARATUS FOR COATING THE EXTERIOR OF ROD-LIKE MEMBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a covering material-coating apparatus and a covering material-coating method.

2. Related Art of the Invention

Heretofore, for example, when a lightning-guard insulator apparatus is to be assembled or produced, a lightning arresting element is placed in an insulating cylinder made of a fiber-reinforced plastic (FRP), and electrode fittings are attached to both ends of the insulating cylinder. A covering material such as a primer (an undercoat such as an adhesive) is coated around the outer periphery of the insulating cylinder, and then an insulating housing is molded of silicone rubber or the like around the insulating cylinder.

When the coating material such as a primer is to be applied to the outer periphery of the insulating cylinder at the time of assembling such a lightning-guard insulator, it is a conventional practice that while a worker is turning the insulating cylinder successively by 120°, a gauze impregnated with the primer is contacted with the insulating cylinder and moved thereon in the circumferential and longitudinal directions to manually effect the coating by three times. When no primer-coated portion is to be formed around the outer periphery of each of the opposite ends of the insulating cylinder corresponding to the electrode fittings, the coating is effected in the state that a masking tape is adhered there.

However, according to the above conventional process, since the primer is manually applied to the workpiece, the coating work is time-consuming, and it is difficult to uniformly coat the primer on the outer peripheral surface of the workpiece.

Further, according to the above conventional process, since the masking tape is adhered to those outer peripheral end portions of the workpiece where no primer is to be coated, it is troublesome and time-consuming to adhere or remove the tape.

SUMMARY OF THE INVENTION

The present invention has been accomplished with due attention to the problems existing as in the above inconventional technique. A principle object of the present invention is to provide a covering material-applying apparatus and a covering material-applying process which can efficiently and uniformly apply the covering material upon the outer periphery of a rod-shaped workpiece.

Another object of the present invention is to provide a covering material-applying apparatus which can easily form an outer peripheral end portion of the workpiece where no coating material is applied.

In order to accomplish the above objects, the coating apparatus according to the present invention for coating an outer peripheral surface of a rod-shaped workpiece with a covering material, comprises an elastic body having a covering material-impregnatable property and provided with an insertion hole through which the workpiece is to be passed, and a moving mechanism for moving the workpiece relative to the elastic body through the insertion hole, wherein the outer peripheral surface of the workpiece is coated with the covering material impregnated in the elastic body, when the workpiece is passed through the insertion hole of the elastic body by the moving mechanism.

Further, the present invention is to provide a process for coating an outer peripheral surface of a rod-shaped workpiece with a covering material by inserting the workpiece through an insertion hole formed in a central portion of elastic body and moving the workpiece relative to the elastic body in a longitudinal direction of the workpiece.

According to the apparatus and the process for coating the outer periphery surface of the workpiece with the covering material in the present invention mentioned above, the rod-shaped workpiece is passed through the insertion hole of the elastic body impregnated with the covering material such as a primer, in this state the workpiece is moved relative to the elastic body in the longitudinal direction of the workpiece by the workpiece-moving mechanism, and thereby the outer peripheral surface of the workpiece is coated with the covering material impregnated into the elastic body. Therefore, the outer peripheral surface of the workpiece can be coated with the covering material in a short time to enhance the workability. Further, the outer peripheral surface of the workpiece can be uniformly coated with the covering material to enhance the quality of the product.

In the following, preferred embodiments of the present invention will be explained. Any of these preferred embodiments may be combined together unless any unacceptable effect occurs.

(1) The coating apparatus further comprises a rotating mechanism for rotating the workpiece. In this case, the outer peripheral surface of the workpiece is coated with the covering material by moving the workpiece relative to the elastic body through the insertion hole in the longitudinal direction of the workpiece, while the workpiece is being rotated by the rotating mechanism. Therefore, the outer peripheral surface of the workpiece can be more uniformly coated with the covering material in a shorter time period. Thereby, the workability and the product quality can be further enhanced.

(2) The coating apparatus comprises a workpiece detecting mechanism for detecting an end portion of the workpiece and outputting a detection signal upon detection of said end portion of the workpiece so that the workpiece-moving mechanism may be stopped at a place corresponding to a location where the the elastic body is spaced from the end portion of the workpiece by a given distance, thereby to stop the relative movement between the workpiece and the elastic body and to not coat an outer peripheral surface of the end portion of the workpiece with the covering material. In this case, the sensor detects the end portion of the workpiece and outputs the detection signal when the workpiece comes to the place corresponding to a location where the the elastic body is spaced from the end portion of the workpiece by a given distance. Thereby, the relative movement between the workpiece is stopped and the elastic body to stop the coating action of the workpiece with the elastic body, and thereby an outer peripheral surface of the end portion of the workpiece not coated with the covering material is formed. Therefore, such an outer peripheral surface of the end portion of the workpiece not coated with the covering material can be easily formed with no use of a masking tape. Thereby, the workability can be largely enhanced.

(3) The elastic body includes two elastic members divided along the insertion hole so that said insertion hole may be opened by spacing the elastic members from each other. Since the elastic body is divided into two elastic members, the insertion hole can be opened along its longitudinal direction by spacing the elastic members from each other. Therefore, the workpiece can be easily attached to and

detached from the insertion hole in the state that the insertion hole is kept opened.

(5) The elastic body is sandwiched by a sandwiching member from opposite sides of the elastic body as viewed in a moving direction of the workpiece, said sandwiching member being made of a material harder than the open-cell type sponge. In this case, the elastic body can be prevented from being deformed in shape during relative movement between the elastic body and the workpiece.

(6) The coating apparatus further comprises a vertically movably concaved cylindrical supporting roller having a recessed portion at a central portion of an outer periphery thereof, said supporting roller being adapted to support the workpiece coated with the covering material. In this case, as the the outer peripheral surface of the workpiece is coated with the covering material by moving the workpiece relative to the elastic body with the moving mechanism, the concaved cylindrical supporting roller is moved up to the workpiece-moving path to support the coated portion of the workpiece at the recessed portion of the central outer peripheral face of the supporting roller. Therefore, the coated workpiece can be supported by the supporting roller in the state that the coated surface of the workpiece is not largely touched. The term "concaved cylindrical supporting roller" means, for example, the shape shown in FIGS. **1**, **2**, **4** and **6** which is formed by joining two frusto-conical bodies at their smaller diameter portions.

(7) The coating apparatus further comprises a hot air generating mechanism arranged downstream the elastic body to dry the covering material coated upon the outer peripheral surface of the workpiece. In this case, after the outer peripheral surface of the workpiece is coated with the covering material by passing the workpiece through the insertion hole, hot air is fed upon the covering material-coated surface of the workpiece by the hot air generating mechanism. Therefore, the covering material coated upon the outer peripheral surface of the workpiece can be dried in a short time.

(8) The coating apparatus further comprises a workpiece feeding mechanism and a workpiece feeding guide mechanism, said workpiece feeding mechanism being adapted for feeding the workpiece to the elastic body and said workpiece feed guide mechanism being adapted for guiding a forward end of the workpiece of the workpiece into the insertion hole of the elastic body. In this case, the steps of feeding the workpiece to the elastic body and aligning and guiding the starting end of the workpiece to the insertion hole of the elastic hole can be easily effected without necessitating a large manual labor.

(9) The coating apparatus further comprises a chucking mechanism for chucking a forward end portion of the workpiece, said chucking mechanism being moved by said workpiece-moving mechanism to pass the workpiece through the insertion hole of the elastic body. In this case, the workpiece can be assuredly moved through the insertion hole of the elastic body to facilitate the coating operation.

(10) The coating apparatus further comprises a moving mechanism movement-detecting mechanism for detecting a location where the coating of the workpiece with the covering material through the insertion hole of the elastic body is to be terminated so as to stop the workpiece-moving mechanism. In this case, the coating step can be stopped at any arbitrary location of the workpiece, so that an end portion of the workpiece to which an end fitting is to be attached may be left uncoated with the covering material.

These and other objects, features and advantages of the invention will be appreciated upon reading of the following description of the invention when taken in conjunction with the attached drawings, with the understanding that some modifications, variations and/or changes could be easily made by the skilled person in the art to which the invention pertains.

BRIEF DESCRIPTION OF THE INVENTION

FIG. **1** is a front view of a principal portion of an embodiment of the covering material-coating apparatus according to the present invention;

FIG. **2** is a front view of a right side portion of the coating apparatus in FIG. **1**;

FIG. **3** is a plane view of the principal portion of the covering material-coating apparatus;

FIG. **4** is a partially broken front view of a coating mechanism and related mechanisms thereof;

FIG. **5** is a sectional view of FIG. **4** along with a line V—V;

FIG. **6** is a sectional view of FIG. **4** along with a line VI—VI;

FIG. **7** is a partially broken front view of a moving mechanism and a turning mechanism for the workpiece;and

FIG. **8** is a sectional side view of a principal portion of the moving mechanism and the rotating mechanism for the workpiece.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the covering material-coating apparatus according to the present invention will be explained below with reference to the attached drawings.

First, this embodiment of the covering material-coating apparatus will be schematically explained with reference to FIGS. **1** to **3**. As shown, a machine frame **11** extending horizontally is placed on a floor via plural supporting legs **12**, and a pair of parallel rails **13** are horizontally laid on the upper surface of the machine frame **11** in a longitudinal direction. A workpiece feeding mechanism **14** is arranged on a forward side of the machine frame **11**, and includes a conveyor frame **15** placed on the floor via plural supporting legs **16** and plural conveyor rollers **17** rotatably supported on the conveyor frame **15** at a given interval. A rod-shaped workpiece **18** having a circular section is supported on the conveyor rollers **17** of the workpiece feed mechanism **14** so that the workpiece **18** may be carried and fed above the machine frame **11**.

A coating mechanism **19** is provided at an upper face of a front end portion of the machine frame **11** (at the upper face of a left end portion in FIGS. **1** and **3**). The coating mechanism **19** includes an elastic body **20** made of an open-cell sponge, which is provided in its central portion with a insertion hole **21** for inserting the workpiece **18** therethrough. For example, the insertion hole **21** has such a size that the elastic body **20** may press the outer periphery of the workpiece **18** at the inner peripheral wall of the insertion hole **21** during the passage of the workpiece through the insertion hole **21**, while the elastic body **20** is not largely deformed near the insertion hole **21**. A primer feed tank **22** is arranged near above the coating mechanism **19**, and a primer as a covering material placed in the tank **22** is fed into the elastic body **20** via a feed pipe **23** so that the elastic body **20** may be impregnated with the primer. In this embodiment, as a primer is used a silicone rubber dissolved in an organic solvent such as toluene (tradename S2260 or SH2260 manufactured by Torey Dow Corning Silicone Co., Ltd.).

A feed/guide mechanism **24** for the workpiece **18** is arranged near in front of the coating mechanism **19**, and guides the workpiece **18** through the insertion hole **21** of the elastic body **20**. A moving table **25** is movably supported on a pair of the rails **13** of the machine frame **11**, and above the moving table **25** are arranged a chucking mechanism **26**, a turning mechanism **27** and a carrying mechanism **28** for the workpiece **18**. A starting end portion of the workpiece **18** inserted through the insertion hole **21** of the elastic body **20** in the coating mechanism **19** is releasably chucked by the chucking mechanism **26**. While the workpiece **18** is chucked by the chucking mechanism **26**, the workpiece **18** is turned around its axis by the turning mechanism **27**, and the moving table **25** is carried by the moving mechanism **28** in a rear direction (to a right side in FIGS. **1** and **3**) to carry the workpiece **18** in the longitudinal direction. By so doing, the workpiece **18** is rotated and moved relative to the elastic body **20** through the through-hole **21**, so that the primer impregnated into the elastic body **20** is applied around the outer periphery of the workpiece **18**.

A hot air generating mechanism **29** is arranged under the front end portion of the machine frame **11**, corresponding to the coating mechanism **19**. The hot air generating mechanism **29** includes a blower **30** with a motor, a heater **31** connected to a discharge side of the blower **30**, and a feed duct **32** connected to the heater **31** and opened above a rear side of the coating mechanism **19**. After the primer is applied onto the outer periphery of the workpiece **18** by the coating mechanism **19**, hot air generated in the heater **31** is blown upon the primer-coated surface of the workpiece **18** through the opening of the feed duct **32**, thereby drying said coated surface.

A plurality of work-moving guide mechanisms **33** are provided at the machine frame **11** such that the mechanisms **33** may be located at a given interval along a moving path of the moving table **25**. Each moving guide mechanism **33** includes a support roller **34** having a liftable concaved barrel shape **34** with an annular recess **34***a* on a central portion of the outer periphery. When the outer peripheral surface of the workpiece **18** is coated with the primer in the state that the workpiece is being moved by the moving mechanism **28** and every time the moving table **25** passes above the moving guide mechanism **33**, the supporting rollers **34** are successively raised to support the workpiece **18** on the recesses **34***a*.

As shown in FIG. **3**, the workpiece-detecting mechanism **35** is arranged in front of the feed guide mechanism **24**, and includes a first sensor **36** and a second sensor **37**. The first sensor **36** includes a light-emitting element **36***a* and a light-receiving element **36***b*, and the second sensor **37** includes a light-emitting element **37***a* and a light-receiving element **37***b*. The workpiece **18** is moved by the moving mechanism **28**. When the terminal end of the workpiece **18** is moved to be opposed to the first sensor **36**, the light-receiving element **36***b* outputs a detection signal, based on which a moving speed of the moving mechanism **28** is reduced. When the terminal end of the workpiece **18** is moved to be opposed to the second sensor **37**, the light-receiving element **37***b* outputs a detection signal, based on which the moving mechanism **28** is stopped. By so doing, a portion P1 not coated with the primer as shown in FIG. **1** is formed around an outer periphery of the terminal end portion of the workpiece **18**.

As is seen in FIG. **1**, after the workpiece **18** is set at the coating mechanism **19** and the chucking mechanism **26**, the moving table **25** begins to be moved to make the coating mechanism **19** coat the workpiece **18** with the primer. Thus, a portion P2 not coated with the primer is formed at an outer periphery of the starting end portion of the workpiece **18**.

As shown in FIG. **3**, a movement detecting mechanism **38** for the moving table **25** is arranged corresponding to a moving path of the chucking mechanism **26**. This movement detecting mechanism **38** includes a dog **39** projecting from the chucking mechanism **26** and first to third approach switches **40**, **41** and **42** to be opposed to the dog **39**. When the chucking mechanism **26** by which the workpiece **18** is chucked is moved to its movement terminal end by the moving mechanism **28**, the dog **39** is opposed to the first approach switch **40** so that the first approach switch **40** may output a detection signal to restrict the location of the movement terminal end of the chucking mechanism **26**.

As the chucking mechanism from which the workpiece **18** is released after being coated is returned from the location of its movement terminal end to its original location, the dog **39** is opposed to the second approach switch **41** so that the second approach switch **41** may output a detection signal to reduce a returning speed of the moving mechanism **28**. Thereafter, when the dog **39** is opposed to the third approach switch **42**, the third approach switch **42** outputs a detection signal to stop the returning movement of the moving mechanism **28**.

Next, the above mentioned mechanisms will be explained in more detail.

First, the coating mechanism **19** will be explained. As shown in FIGS. **4** and **5**, a supporting plate **45** is liftably supported above the machine frame **11** via a pair of guide rods **46** and a lift cylinder **47**. The supporting frame **45** is moved, by actuating the lift cylinder **47**, between an upper location corresponding to the location of the workpiece **18** and a lower location spaced from that location of the workpiece **18**. A receiving vessel **48** is arranged on the upper face of the supporting plate **45** via a receiving tray **49**, and is binarily divided into a lower vessel **48***a* and an upper vessel **48***b*. The lower vessel **48***a* is fixed to the supporting plate **45** via the receiving tray **49**, and the upper vessel **48***b* is arranged above the lower vessel **48***a* via supporting arms **50** and **51** and a supporting shaft such that the upper vessel **48***b* may be opened or closed relative to the lower vessel **48***a*. At a top portion of the upper vessel **48***b* is formed a feed opening **53** to be connected to a primer feed pipe **23**, and at a side wall of the lower vessel **48***a* is formed an overflow opening **54** for overflowing the primer.

The elastic body **20** made of open-cell sponge is vertically and binarily divided into lower and upper elastic members **20***a* and **20***b* along the insertion hole **21**. The lower and upper elastic members **20***a* and **20***b* are exchangeably received in the lower and upper vessels **48***a* and **48***b* of the receiving vessel **48**, respectively. Sandwiching bodies **55** made of an elastic material such as rubber harder than that of the open-cell sponge are joined to the opposite side faces of the elastic body **20** so that the sandwiching bodies **55** may sandwich the elastic body **20** from opposite sides along the moving direction of the workpiece. In a central portion of each of the sandwiching bodies **55** is formed a through-hole **56** tapered as shown, corresponding to the insertion hole **21** of the elastic body **20**. Each sandwiching body **55** is binarily divided into a lower sandwiching member **55***a* and an upper sandwiching member **55***b* along the through-hole **56** as is the same with the elastic body **20**.

An opening/closing cylinder **57** is rotatably supported at the supporting arm **50** fixed to the lower vessel **48***a*, and a piston rod **57***a* is connected to the supporting arm **51** at the upper vessel **48***b*. When the opening/closing cylinder **57**

outwardly projects the piston rod **57***a*, the upper vessel **48***b* is turned to a closing position above the lower vessel **48***a* as shown by solid lines in FIG. **5** so that the insertion hole **21** is closedly formed inside the elastic body **20** to allow the insertion of the workpiece **18** therethrough. When the opening/closing cylinder **57** retracts the piston rod **57***a*, as shown by two-dotted lines in FIG. **5**, the upper vessel **48***b* is turned to an upper opened location, so that the insertion hole **21** of the elastic body **20** is opened to allow setting and releasing of the workpiece **18** relative to the insertion hole **21**.

As shown by a two-dotted line in FIG. **5**, the primer fed inside the receiving vessel **48** through the feed opening **53** is stored inside the lower vessel **48***a* at a given level L1, and excess primer is overflown into the receiving tray **49** through the overflow opening **54**. In this state, the workpiece **18** is rotated by the rotating mechanism **27** and moved by the moving mechanism **28** through the insertion hole **21** of the elastic body **20**. Consequently, the primer is applied to the outer peripheral surface of the workpiece **18** mainly by the lower elastic body **20***a*, and the entire peripheral surface of the workpiece **18** is coated with the primer in a uniform thickness by the upper elastic member **20***b*. The rotating speed of the workpiece **18** by the rotating mechanism and the moving speed of the workpiece **18** by the moving mechanism **28** are so set that the primer may be applied upon the outer peripheral surface of the workpiece **18** twice during the coating.

Next, the workpiece feeding guide mechanism **24** will be explained. As shown in FIGS. **4** and **6**, a bracket **60** is erected on the machine frame **11**, and a fitting plate **61** is fixed to a side portion of the bracket **60**. A supporting roller **62** is rotatably supported above the fitting plate **61** via a supporting plate **63** such that the supporting roller **62** may be turned around a axis S1 shifted relative to the moving direction of the workpiece **18** at a given angle (45° in this embodiment). The supporting roller **62** has a concaved barrel shape, and an annular recess **62***a* is formed in a central portion of the outer periphery. As shown in FIG. **6**, the workpiece **18** is slidably supported by the recess **62***a* of the supporting roller **60**, and is led through the insertion hole **21** of the elastic body **20** in the coating mechanism **19**.

A fitting plate **64** is fixed to an upper end of the bracket **60**, and a lift plate **66** is liftably supported under the fitting plate **64** via a pair of guide rods **65**. A press roller **67** is rotatably supported under the lift plate **66** via a supporting plate **68** such that the supporting roller **67** may be turned around a axis S2 shifted relative to the moving direction of the workpiece **18** at a given angle (45° in this embodiment) in an opposite shift direction of the axis S1. As is the same with the supporting roller **62**, the supporting roller **67** has a concaved barrel shape, and an annular recess **67***a* is formed in a central portion of the outer periphery.

Under the fitting plate **64** is fitted a lift cylinder **69**, which moves up and down the lift plate **66** to displace the press roller **67** away from or near to the supporting roller **62**. As the press roller **67** is moved nearer to the supporting roller **62**, the press roller **67** is descended down to a location where the recess **67***a* contacts the upper peripheral surface of the workpiece **18** depending upon the outer diameter of the workpiece **18**. In this state, the workpiece **18** is sandwiched between the rollers **62** and **67**. Further, the press roller **67** is moved apart from the supporting roller **62**, the upper side of the supporting roller **62** is opened to allow the setting or detaching of the workpiece **18** relative to the recess **62**.

Next, the above workpiece-chucking mechanism **26** will be explained. As shown in FIGS. **7** and **8**, a pair of rails **72** are provided on the upper face of the moving table **25**, and extends in the same direction of the rails **13** on the machine frame **11**. A supporting plate **73** is movably supported upright on the rails **72**, and a through-hole **73***a* is formed in a central portion of the supporting plate **73**. A pair of guides **73***b* are vertically extended in parallel at side portions of the supporting plate **73**. A fitting plate **74** is vertically movably supported between the guides **73***b* of the supporting plate **73**, and a bearing cylinder **75** is provided on one side of the fitting plate **74** through the through-hole **73***a*, whereas a gear box **76** is fixed to the other side thereof. A cylindrical rotary shaft **77** is rotatably supported in the bearing cylinder **75** via a pair of bearings **78**, and to a tip of the rotary shaft **77** is fitted a chucking head **79** having a plurality of chucking claws **79***a*.

An air port **80** is fitted to a base end of the rotary shaft **77**, and air is fed to or discharged from a chuck opening/closing mechanism (not shown) inside the chucking head **79** through the rotary shaft **77** from the air port **80** to open or close the chucking claws **79**. When the chucking claws are closed, the starting end portion of the workpiece **18** is chucked between the chucking claws **79**. On the other hand, when the chucking claws **79***a* are opened, the workpiece **18** can be set to or detached from between the chuck claws **79***a*.

A guide plate **81** is elected above the moving table **25** via a fitting plate **82**, corresponding to the chuck head **79**, and at an upper end of the guide plate **81** is provided a V-shaped recess **81***a* for guiding the starting end portion of the workpiece **18** between the chucking claws **79**. A moving cylinder **83** is fitted to a side face of the fitting plate **82**, and a piston rod **83***a* is connected to the supporting plate **73**. When the moving cylinder **83** retracts the piston rod **83***a*, the supporting plate **73** is moved to the left side in FIG. **7** so that the chucking head **79** may be located at a location where the starting end portion of the workpiece **18** is chucked. When the moving cylinder **83** outwardly projects the piston rod **83***a*, the supporting plate **73** is moved to the right side of the in this Figure so that the chucking head **79** may be located at a location where the workpiece **18** is released from the chucking head.

An adjusting screw **84** is rotatably supported by an upper end of the supporting plate **73** and screwed to the fitting plate **74** at a lower end portion, whereas its upper end is provided with an operating handle **85**. As the adjusting screw **84** is turned by the operating handle **85**, the fitting plate **74**, the bearing cylinder **75** and the gear box **76** are vertically and integrally moved so that the axis of the rotary shaft **77** may be aligned with that of the workpiece **18**. Therefore, if the outer diameter of the workpiece **18** is changed, the chucking head **79** can be easily moved to a location conforming with the starting end portion of the workpiece **18**.

Next, the workpiece-rotating mechanism **27** will be explained. As shown in FIGS. **7** and **8**, a rotary motor **88** is fitted to an outer face of the gear box **76**, and its motor shaft **88a** projects into the gear box **76**. A driving gear **89** is fitted to the motor shaft **88**, and a driven shaft **90** is fitted to the rotary shaft **77** and meshes with the driving gear **89**. While the workpiece **18** is chucked between the chucking claws **79***a* of the chucking head **79**, the motor **88** rotates the rotary shaft **77** via both the gears **89** and **90** to exert a rotary force upon the workpiece **18**.

Next, the workpiece-moving mechanism **28** will be explained. As shown in FIGS. **7** and **8**, a rack **93** is fitted to a side portion of the machine frame **11**, and extends in the same direction as the rails **13**. A moving motor **94** is arranged above the moving table **25** via a bracket **95**, and a

motor shaft **94***a* projects from the under face of the motor **94**. A pinion **96** is fitted around the motor shaft **94***a* of the moving motor **94**, and meshes with the rack **93**.

When the moving motor **94** is rotated in one direction in the state that the workpiece **18** is being chucked between the chucking claws **79***a* of the chucking head **79**, the moving table **25** is moved to the right side in FIGS. **1** and **2** via the pinion **96** and the rack **93** so that the workpiece **18** may be moved to the same side. After the workpiece **18** is released from the chucking claws of the chucking head **79** at the location of the movement terminal end, the moving motor **94** is rotated in the reverse direction so that the moving table **25** may be moved back to the original position via the pinion **96** and the rack **93**.

Next, the work-moving guide mechanism **33** will be explained. As shown in FIGS. **1** to **3**, a lift plate **99** is vertically movably supported by the machine frame **11** via a pair of guide rods **100**. The above supporting roller **34** is supported above the lift plate **99** via a supporting plate **101** such that the supporting roller **34** may be rotatable around an axis S3 shifted at a given angle (45° in this embodiment), relative to the moving direction of the workpiece **18**, in the same direction of the supporting roller **62** of the feeding guide mechanism **24**.

A lift cylinder **102** is fitted to the under face of the machine frame **11**, and its piston rod **102***a* is connected to the lift plate **99**. While the workpiece **18** is being moved by the moving mechanism **28**, the primer is applied around the outer peripheral surface of the workpiece **18**. At that time, as shown by the two-dotted lines in FIG. **2**, every time the moving table **25** passes above each moving guide mechanism **33**, the lift cylinder **102** outwardly projects the piston rods **102***a* to move up the lift plate **99**. By so doing, the workpiece **18** is supported by the recess **34***a* of the supporting roller **34** having the almost concaved barrel shape, while its coated surface does not largely contact the supporting roller **34**.

The operation of the primer-coating apparatus thus constructed will be explained.

When a workpiece-setting switch on an operation panel not shown is turned on, in the coating mechanism **19**, the receiving vessel **48** is moved downwardly to its lower position by the lift cylinder **47**, and the upper vessel **48***b* is turned to its open location above the lower vessel **48***a* by the lift cylinder **47**. In the chucking mechanism **26**, the chucking head **79** is moved to the left chucking position from its original position shown in FIG. **1** by the moving cylinder **83**. At that time, the chucking claws **79***a* of the chucking head **79** are kept opened.

In this state, the workpiece **18** is fed and set between the chucking claws **79** of the chucking head **79** in the chucking mechanism **26** through both the vessels **48***a* and **48***b* in the coating mechanism **19** by means of the roller conveyor **17** of the workpiece-feeding mechanism **14**. Thereafter, when a start switch on the operation panel not shown is turn on, in the coating mechanism **19**, the receiving vessel **48** is moved from its lower position to its upper position by the lift cylinder **47**, and the upper vessel **48***b* is turned to its closing position above the lower vessel **48***a* by the opening/closing cylinder **57**. By so doing, the upper elastic member **20***b* is closely contacted with the lower elastic member **20***a* so that the through hole **21** may be formed between both the elastic members **20***a* and **20***b*. The workpiece **18** is inserted through the insertion hole **21**.

At that time, air is fed to the not shown opening/closing mechanism inside the chucking head **79** in the chucking mechanism **26** from the air port **80** through the rotary shaft **77** to close the chucking claws **79***a*. Thereby, the start end portion of the workpiece **18** is chucked between the chucking claws **79***a*. In the workpiece-feeding guide mechanism **24**, the pressing roller **67** is moved down by the lift cylinder **69** so that the workpiece **18** may be sandwiched between the supporting roller **62** and the pressing roller **67**.

In this state, the primer is fed into the receiving vessel **48** of the coating mechanism from the primer tank **22** to immerse the elastic body **20**. While the moving mechanism **28** is kept stopped, the rotary shaft **77** is turned by the rotating motor **88** of the rotating mechanism **27** so that the workpiece **18** may be turned via the chucking head **79** for a given time period only. By so doing, the primer is wet-coated on the outer peripheral surface of the workpiece **18** in the state that the workpiece contacts the inner periphery of the insertion hole **21** of the elastic body **20**. At that time, as shown in FIG. **1**, since the elastic body **20** of the coating mechanism **19** slidably contacts the workpiece **18** at a location spaced from the starting end by a given distance, a portion P2 not coated with the primer is formed around the outer peripheral surface of the starting end of the workpiece **18**.

After a predetermined time lapses following the start of the coating, the moving table **25** is moved rearwardly (to the right in FIGS. **1** to **3**) by the moving motor **94** to move the workpiece **18** in the same direction. Consequently, while the workpiece **18** is being rotated, it is moved relative to the elastic body **20** of the coating mechanism **19** through the insertion hole **21**, so that the primer impregnated into the elastic body **20** is successively wet-on-wet coated twice onto the outer peripheral surface of the workpiece **18**. At that time, hot air is blown upon the primer-coated surface of the workpiece **18** through the feed duct **32** from the hot air generating mechanism **29**, so that the primer applied onto the outer peripheral surface of the workpiece **18** is dried in a short time.

When the moving table **25** passes above the moving guide mechanism **32** during coating the primer around the workpiece **18**, as shown in FIG. **2** by the two-dotted lines, the almost barrel-shaped supporting roller **34** is moved up by the lift cylinder **102** of the moving guide mechanism **33**. Therefore, as the workpiece **18** is moved rearwardly, it is successively supported by the recesses **34***a* of the supporting rollers **34** of the moving guide mechanisms **33** while the coated surface of the workpiece is not largely contacted with the supporting rollers **34**.

As shown in FIG. **3** by the two-dotted lines, when the terminal end portion of the workpiece **18** is opposed to the first sensor **36** of the workpiece-detecting mechanism **35**, the light-receiving element **36***b* outputs a detection signal, based on which the moving speed of the moving mechanism **28** is reduced. Thereafter, when the terminal end portion of the workpiece **18** is opposed to the second sensor **37**, the light-receiving element **37***b* outputs a detection signal. Based on this detection signal, the movement of the moving mechanism **28** is stopped, and the operation of the hot air generating mechanism **29** is stopped. As a result, while the workpiece **18** is merely rotated, the primer is wet-on-wet coated upon the workpiece **18** at a location spaced from the terminal end by a given distance, the portion P1 of the workpiece being not coated with the primer.

After a predetermined time lapses following the stoppage of the moving mechanism **28**, the rotating mechanism **27** is stopped. At that time, in the coating mechanism **19**, the upper vessel **48***b* is turned to the open location above the

lower vessel **48***a* by the opening/ closing cylinder **57**, while the receiving vessel **48** is moved to its lower position by the lift cylinder **24**. In the workpiece feeding guide mechanism **24**, the press roller **67** is moved up apart from the upper outer peripheral surface of the workpiece by the lift cylinder **69**.

In the chucking mechanism **26**, feeding of air into the opening/closing mechanism inside the chucking head **79** is stopped, so that the chucking claws **79***a* are opened to release the chucking of the workpiece **18**. Thereafter, the supporting plate **73** is moved to the right side in FIGS. **1** and **7** by the moving cylinder **83**, and the chucking head **79** is moved to a location spaced from the starting terminal end of the workpiece **18**. Therefore, in this state, the completely coated workpiece **18** can be easily taken out above from the support rollers **34** of the moving guide mechanism **33**.

Then, when the return switch on the operation panel not shown is turned on, the supporting plate **73** is moved to the left side in FIGS. **1** and **7** by the moving cylinder **83** of the chucking mechanism **26**, so that the chucking head **79** is returned to the position for chucking the workpiece **18**. At that time, the moving table **25** is moved forwardly (to the left side in FIGS. **1** to **3**) by the moving motor **94** of the moving mechanism **28**, the chucking mechanism **26**, the rotating mechanism **27** and the moving mechanism **28** are returned to their respective original positions.

When the dog **39** of the movement detecting mechanism **38** is opposed to the second approach switch **41** during the above returning operation, the second approach switch **41** outputs a detection signal, based on which the returning speed of the moving mechanism **28** is reduced. Then, when the dog **39** is opposed to the third approach switch **42**, the third approach switch outputs a detection signal, based on which the returning operation of the moving mechanism **28** is stopped. In this state, an original point-indicating lamp is lit on the operation panel not shown, and the apparatus waits for setting of a next workpiece **18**.

As mentioned above, according to this embodiment of the primer-coating apparatus, while the rod-shaped workpiece **18** is inserted through the insertion hole **21** in the central portion of the elastic body **20**, the workpiece and the elastic body **20** are moved relative to each other by the moving mechanism **28** to coat the primer impregnated into the elastic body **20** around the workpiece **18**. Therefore, the primer can be coated around the outer peripheral surface of the workpiece **18** in a short time to enhance the workability. Further, the coating quality can be improved.

In addition, according to this embodiment of the primer-coating apparatus, when the workpiece **18** is to be coated with the primer, it is moved relative to the elastic body **20** by the moving mechanism **28** in the longitudinal direction, while being rotated by the rotating mechanism **27**. Therefore, the primer can be uniformly coated upon the outer peripheral surface of the workpiece **18** in a shorter time period with the result that the workability and the coating quality can be enhanced.

Furthermore, according to this embodiment of the primer-coating apparatus, as the workpiece **18** is coated with the primer, the sensor **37** outputs a detection signal when the elastic body **20** comes to be opposed to a given location of the workpiece spaced from the end of the workpiece **18** by a predetermined distance. Consequently, the moving mechanism **28** is stopped based on this detection signal. Therefore, the portion not coated with the primer can be easily formed around the outer peripheral surface of the end of the workpiece **18** without necessity of adhering a masking tape therearound.

Further, according to this embodiment of the primer-coating apparatus, since the elastic body **20** is binarily divided into the lower elastic member **20***a* and the upper elastic member **20***b*, the insertion hole **21** can be opened by separating the upper elastic member **20***b* from the lower elastic member **20***a*. Therefore, while the insertion hole **21** is kept open, the workpiece **18** can be easily attached to or detached from the insertion hole **21**.

Furthermore, according to this embodiment of the primer-coating apparatus, since the elastic body **20** is made of the open-cell type sponge, the primer can be fully impregnated into the entire elastic body **20**. Therefore, the outer peripheral surface of the workpiece **18** can be uniformly coated with the elastic body **20** into which the primer is fully impregnated.

In addition, according to this embodiment of the primer-coating apparatus, the elastic body **20** made of the open-cell type sponge is held between the sandwiching members **55** made of a material harder than the open-cell type sponge from the opposite side faces. Therefore, the shape of the elastic body **20** can be prevented from being deformed due to the relative movement between the workpiece **18** and the elastic body **20** during the coating.

Furthermore, according to this embodiment of the primer-coating apparatus, when the primer is coated upon the outer peripheral surface of the workpiece **18** in the state that the workpiece **18** is being moved relative to the elastic body **20** by the moving mechanism **28**, the almost barrel-shaped supporting rollers **34** are successively moved up to the moving path of the workpiece **18**. Accordingly, the primer-coated workpiece **18** can be supported by the recesses **34***a* in the central portions of the outer peripheral faces of the respective supporting rollers **34** without being largely contacted with the support rollers. In addition, since the supporting roller **62** and the press roller **67** are inclined relative to the workpiece-passing path reversely at 45°, the workpiece **18** can be effectively prevented from slipping from the supporting roller.

Further, according to this embodiment of the primer-coating apparatus, the primer is coated upon the outer peripheral surface of the workpiece **18** when the workpiece **18** passes the insertion hole **21** of the elastic body **20**, and then hot air is fed upon the primer-coated surface of the workpiece **18** by the hot air generating mechanism **29**. Therefore, the primer coated around the outer peripheral surface of the workpiece **18** can be dried in a short time.

Modifications of the present invention can be made as follows.

(a) Contrary to the above embodiment, the workpiece **18** is not moved, but instead the coating mechanism **18** with the elastic body **20** is moved by the moving mechanism **28** in the longitudinal direction of the workpiece **18** so that the primer impregnated into the elastic body **20** may be coated upon the outer peripheral surface of the workpiece **18**.

(b) By rotating the roller conveyors **17** of the workpiece feeding mechanism **14** with use of a driving source such as a motor, the workpiece **18** can be automatically set to the coating mechanism **18** and the chucking mechanism **26**.

(c) A workpiece discharging mechanism is arranged in parallel on a rear side of the machine frame **11** so that the workpiece **18** finishing its coating step and released from the chucking mechanism **26** may be automatically discharged from the work moving guide mechanism **33**.

(d) An adhesive or a paint is used instead of the primer as the coating agent.

(e) A cylindrical workpiece is coated instead of the rod-shaped workpiece.

In the following, the technical ideas encompassed by the present invention which can be grasped based on the above-mentioned embodiment will be explained.

(1) The open-cell type sponge is received in the receiving vessel, and the receiving vessel is provided with the overflow opening to overflow the excess amount of the covering material impregnated into the open-cell type sponge. By so constructing, the covering material impregnated into the open-cell type sponge can be set at a given level inside the sponge so that the workpiece may be appropriately coated with the covering material.

(2) The supporting rollers are provided at plural locations, and each supporting roller is moved up when the coated workpiece passes above the supporting roller. By so constructing, the coated workpiece can be smoothly supported.

(3) The moving speed at which the workpiece is moved by the moving mechanism and the rotating speed at which the workpiece is rotated by the rotating mechanism are so set that the outer peripheral surface of the workpiece is wet-on-wet coated with the covering material. By so doing, the workpiece can be fully and assuredly coated with the covering material without leaving a uncoated outer peripheral surface portion of the workpiece.

(4) A pair of the upper and lower almost concaved cylindrical supporting rollers each having a recessed portion at a central outer periphery are provided to sandwich the workpiece to be passed through the insertion hole. By so constructing, the workpiece can be smoothly fed into the insertion hole of the elastic body.

(5) A pair of the above upper and lower almost concaved cylindrical supporting rollers have their rotary axes inclined relative to the moving path of the workpiece in reverse directions. By so constructing, the workpiece can be prevented from being slid so that the workpiece can be assuredly fed through the insertion hole of the elastic body.

What is claimed is:

1. A coating apparatus for coating an outer peripheral surface of a core member of an insulator with a covering material, comprising:

an elastic body having an inpregnatable covering material and provided with an insertion hole through which the core member is to be passed,

a moving mechanism for moving the core member relative to the elastic body longitudinally through the insertion hole, and

a rotating mechanism for rotating the core member,

wherein the outer peripheral surface of the core member is coated with the covering material impregnated in the elastic body, when the core member is passed through the insertion hole of the elastic body by the moving mechanism and rotated by the rotating mechanism.

2. The coating apparatus set forth in claim **1**, which further comprises a core member-detecting mechanism for detecting an end portion of the core member and outputting a detection signal upon detection of said end portion of the core member so that the core member-moving mechanism may be stopped at a place corresponding to a location where the elastic body is spaced from the end portion of the core member by a given distance, thereby to stop the relative movement between the core member and the elastic body and to not coat an outer peripheral surface of the end portion of the core member with the covering material.

3. The coating apparatus set forth in claim **1**, wherein said elastic body includes two elastic members divided along the insertion hole so that said insertion hole may be opened by spacing the elastic members from each other.

4. The coating apparatus set forth in claim **1**, wherein said elastic body comprises an open-cell type sponge.

5. The coating apparatus set forth in claim **3**, wherein said elastic body comprises an open-cell type sponge.

6. The coating apparatus set forth in claim **4**, wherein said elastic body is sandwiched by a sandwiching member from opposite sides of the elastic body as viewed in a moving direction of the core member, said sandwiching member being made of a material harder than the open-cell type sponge.

7. The coating apparatus set forth in claim **5**, wherein said elastic body is sandwiched by a sandwiching member from opposite sides of the elastic body as viewed in a moving direction of the core member, said sandwiching member being made of a material harder than the open-cell type sponge.

8. The coating apparatus set forth in claim **1**, which further comprises a concaved cylindrical supporting roller having a recessed portion at a central portion of an outer periphery thereof, said supporting roller being moved up and down to support the core member coated with the covering material.

9. The coating apparatus set forth in claim **1**, which further comprises a hot air generating mechanism arranged downstream, from the elastic body to dry the covering material coated upon the outer peripheral surface of the core member.

10. The coating apparatus set forth in claim **1**, which further comprises a core member feeding mechanism and a core member feeding guide mechanism, said core member feeding guide mechanism being adapted for feeding the core member to the elastic body and said core member feed guide mechanism being adapted for guiding a forward end of the core member into the insertion hole of the elastic body.

11. The coating apparatus set forth in claim **1**, which further comprises a chucking mechanism for chucking a forward end portion of the core member, said chucking mechanism being moved by said core member-moving mechanism to pass the core member through the insertion hole of the elastic body.

12. The coating apparatus set forth in claim **1**, which further comprises a moving mechanism movement-detecting mechanism for detecting a location where the coating of the core member with the covering material through the insertion hole of the elastic body is to be terminated so as to stop the core member-moving mechanism.

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